Pit Tagging of Chinook Salmon Juveniles in Lake Washington Basin: *What Have We Learned from 2003 and Earlier Results?*

Paul DeVries

R2 Resource Consultants

2003 Study Participants

- Chuck Ebel, Fred Goetz
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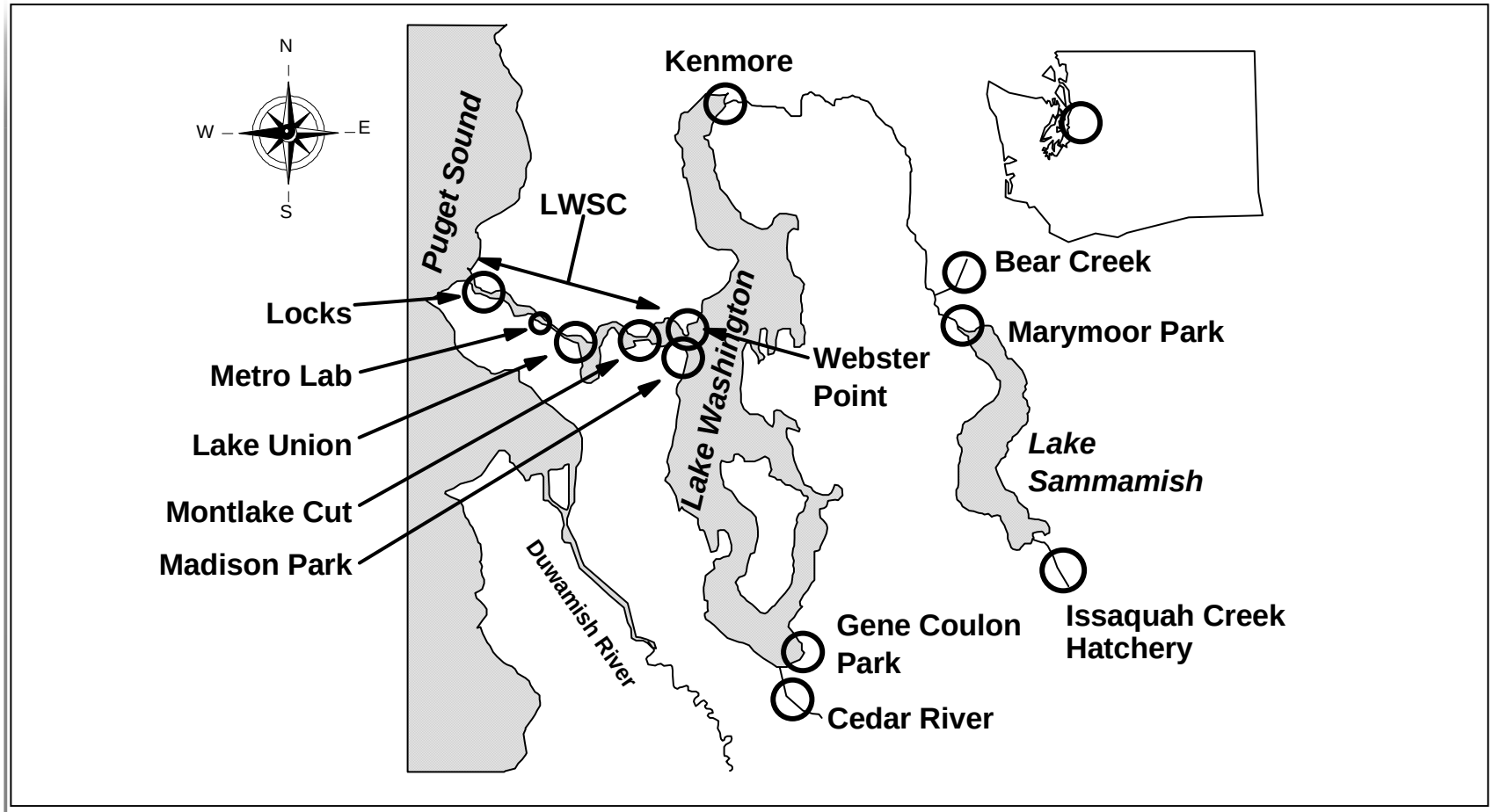
- Agencies: CoE, SPU, KC/M, WDFW

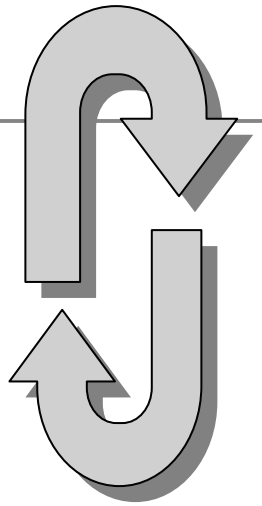
More Release Sites in 2003



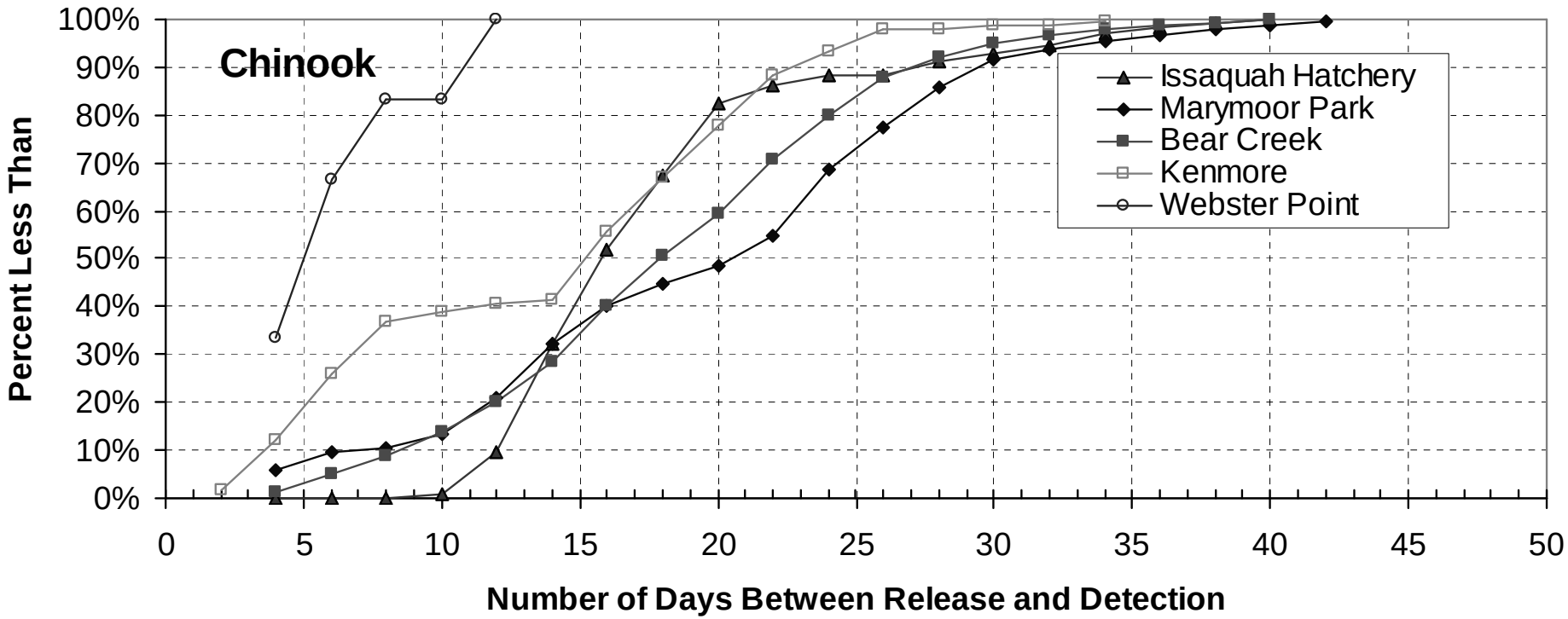
2003 (& 2000-2002) Findings

- Migration Behavior, Rates & Survival
  - Lake vs. Stream, Shoreline Affinity
- Water Temperature & Outmigration
  - Declining Detection Rates, Residualism
- Passage Behavior at Locks
  - Apogee, Diurnal, Recycling
- Passage Rates & Operations
  - Small Lock Operations, Flume Discharge
- Survival (?)

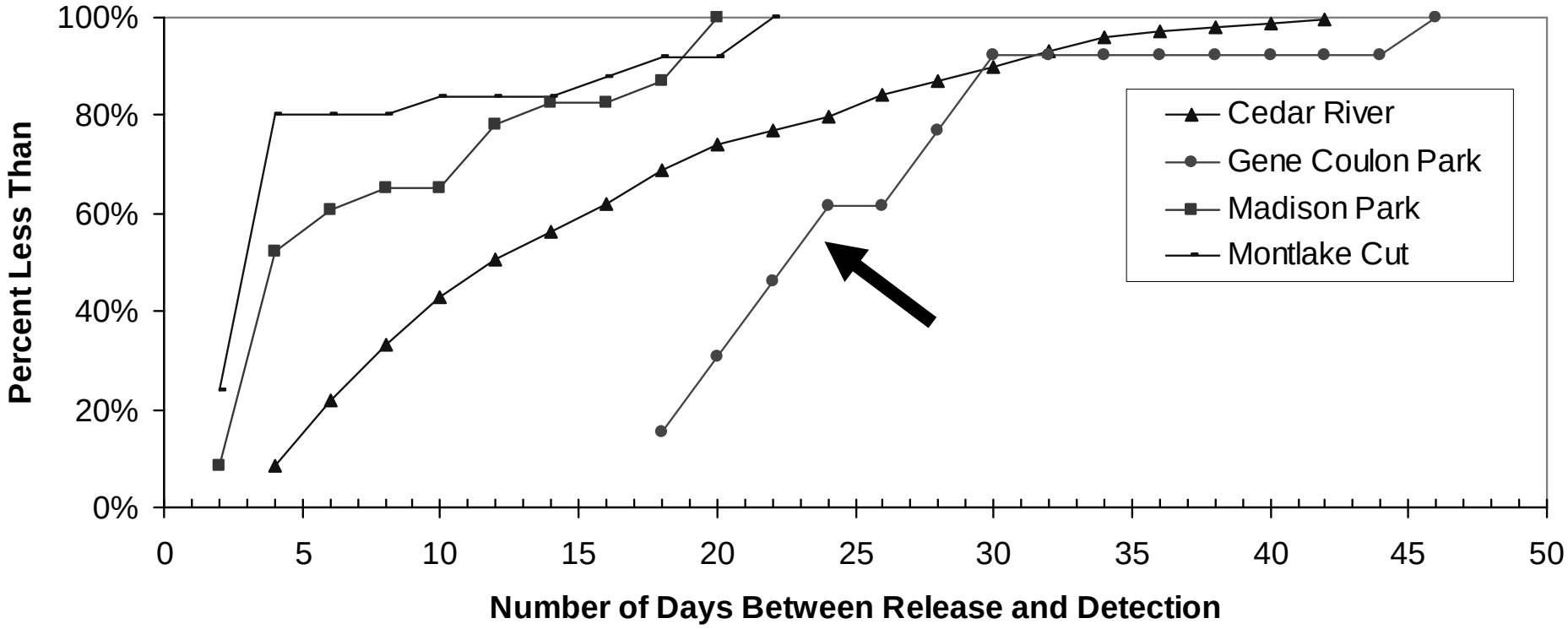
Migration Behavior



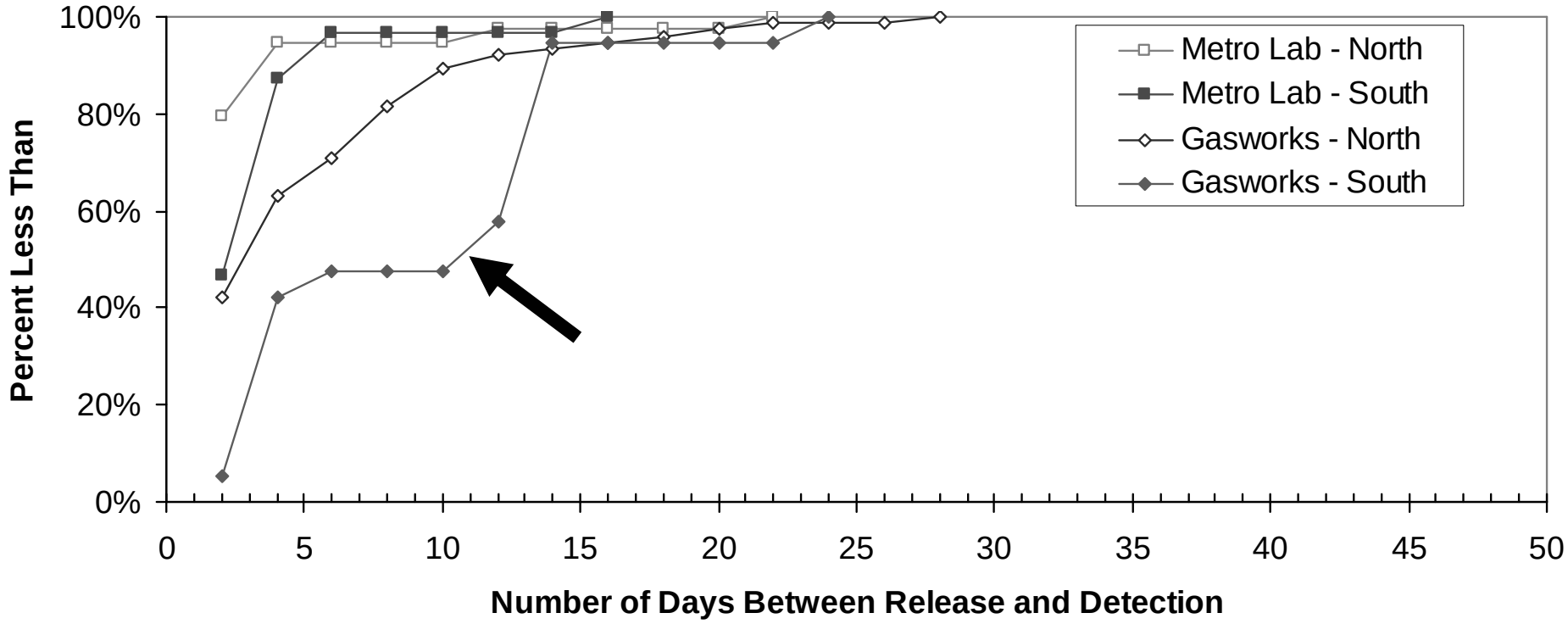
Migration Rate in 2003



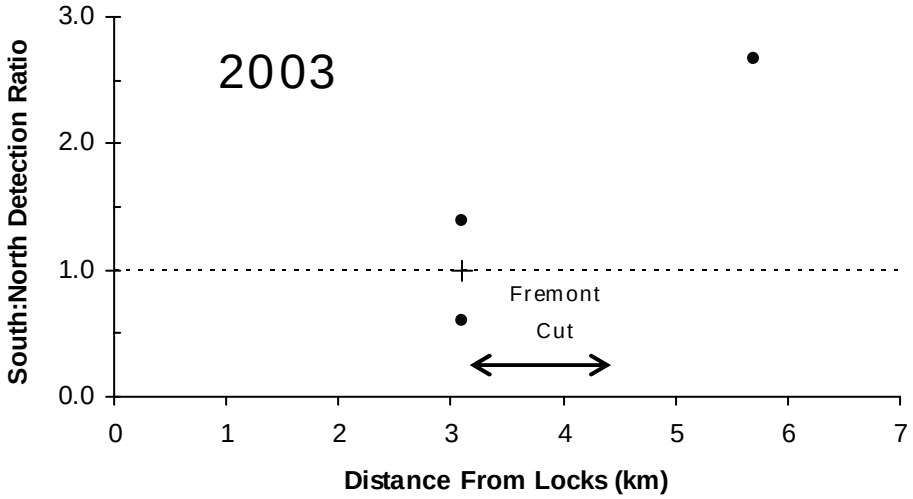
Migration Rate in 2003

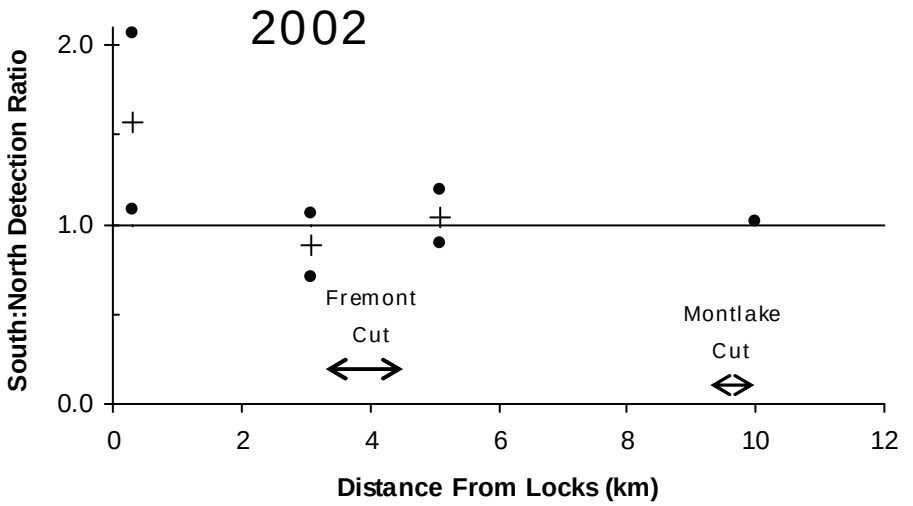


Migration Rate in 2003



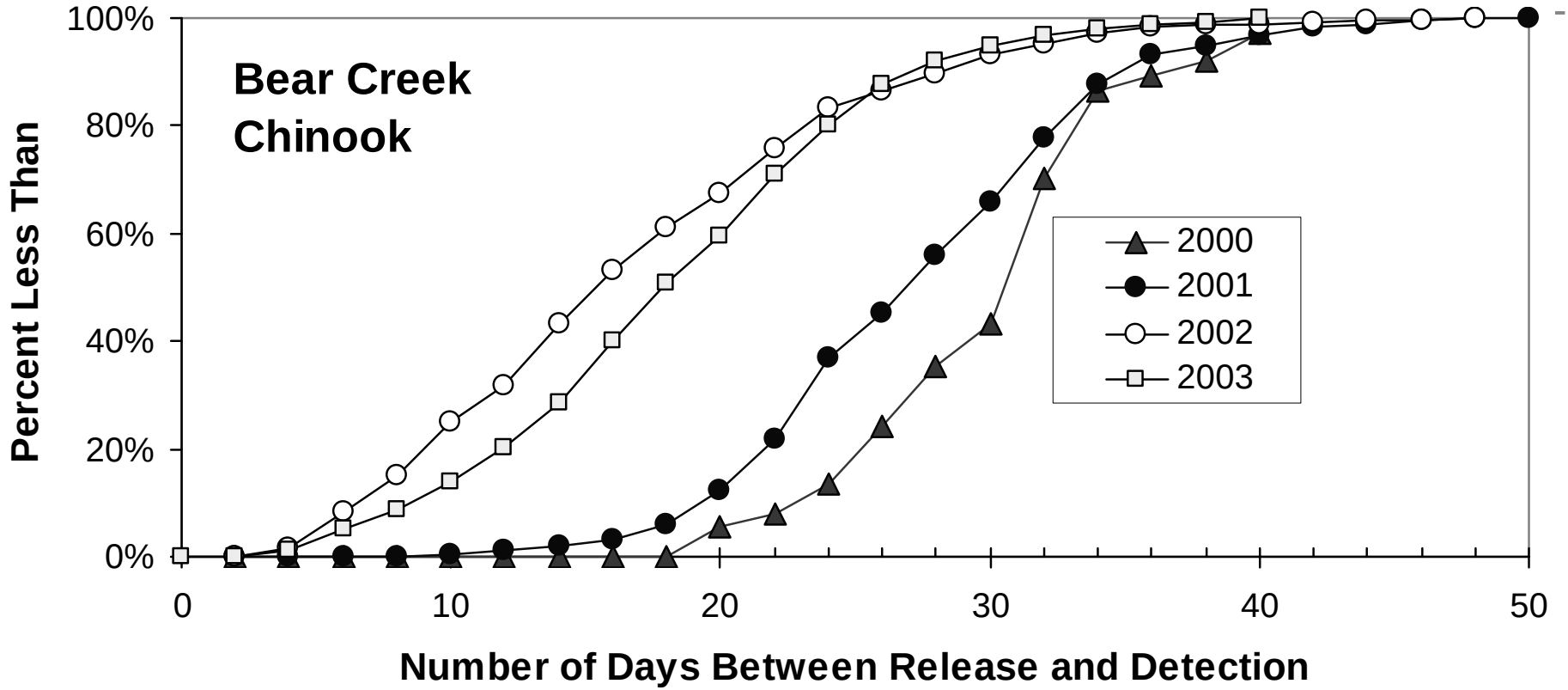
Indirect Evidence for Shoreline Affinity in Lakes, Mixing in Fremont/Montlake Cuts?



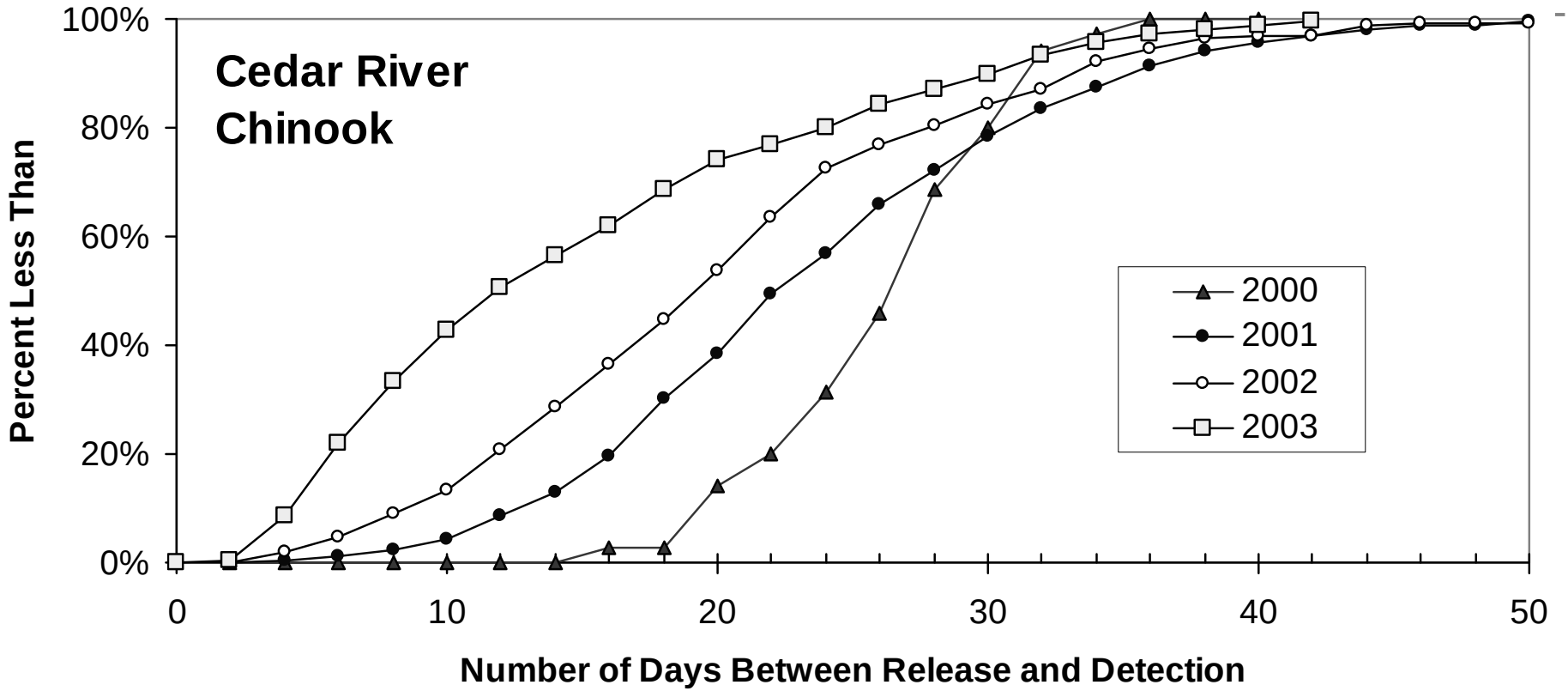


- Issaquah Hatchery Fish in Cedar River
- Shoreline Affinity Tests in 2002, 2003
- Longer travel time for Gene Coulon, South Lake Union Fish

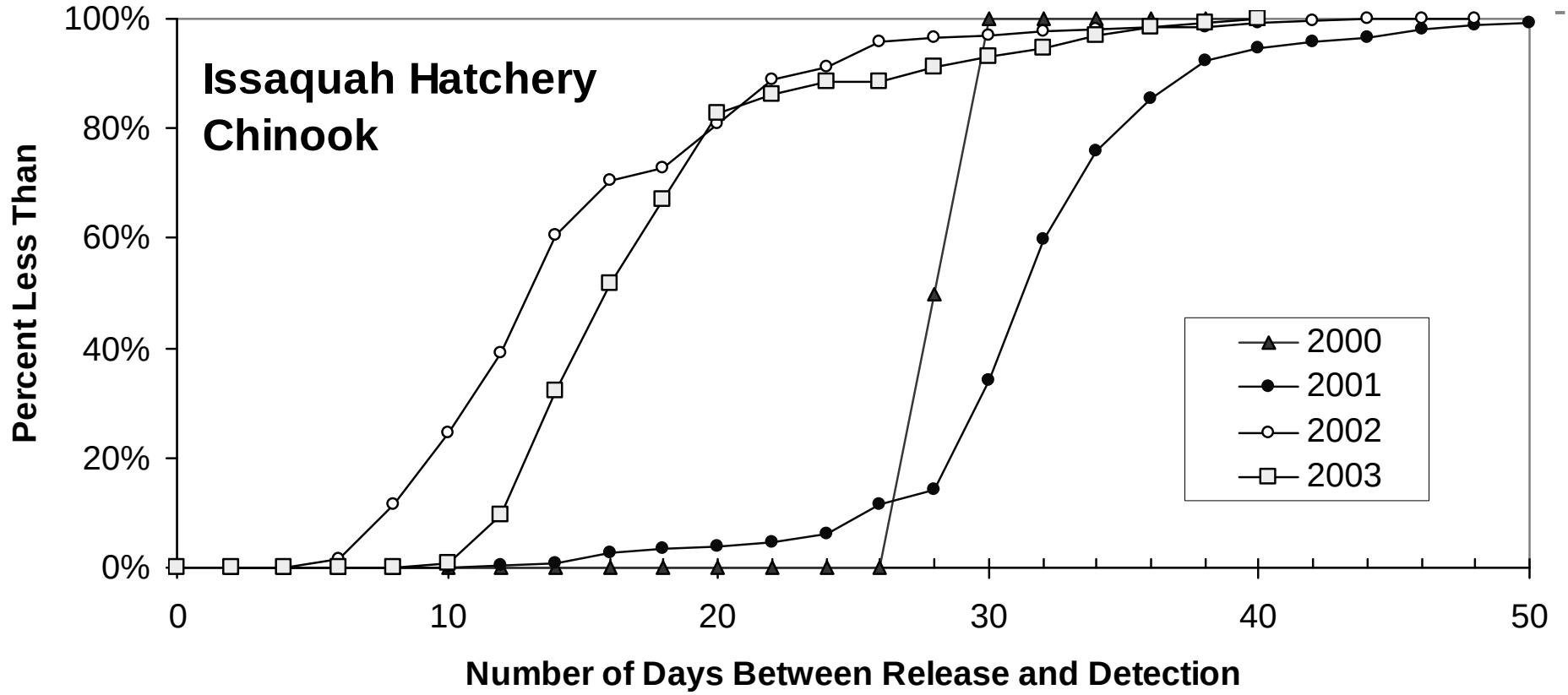
Annually & Spatially Variable Migration Rates



Annually & Spatially Variable Migration Rates



Annually & Spatially Variable Migration Rates

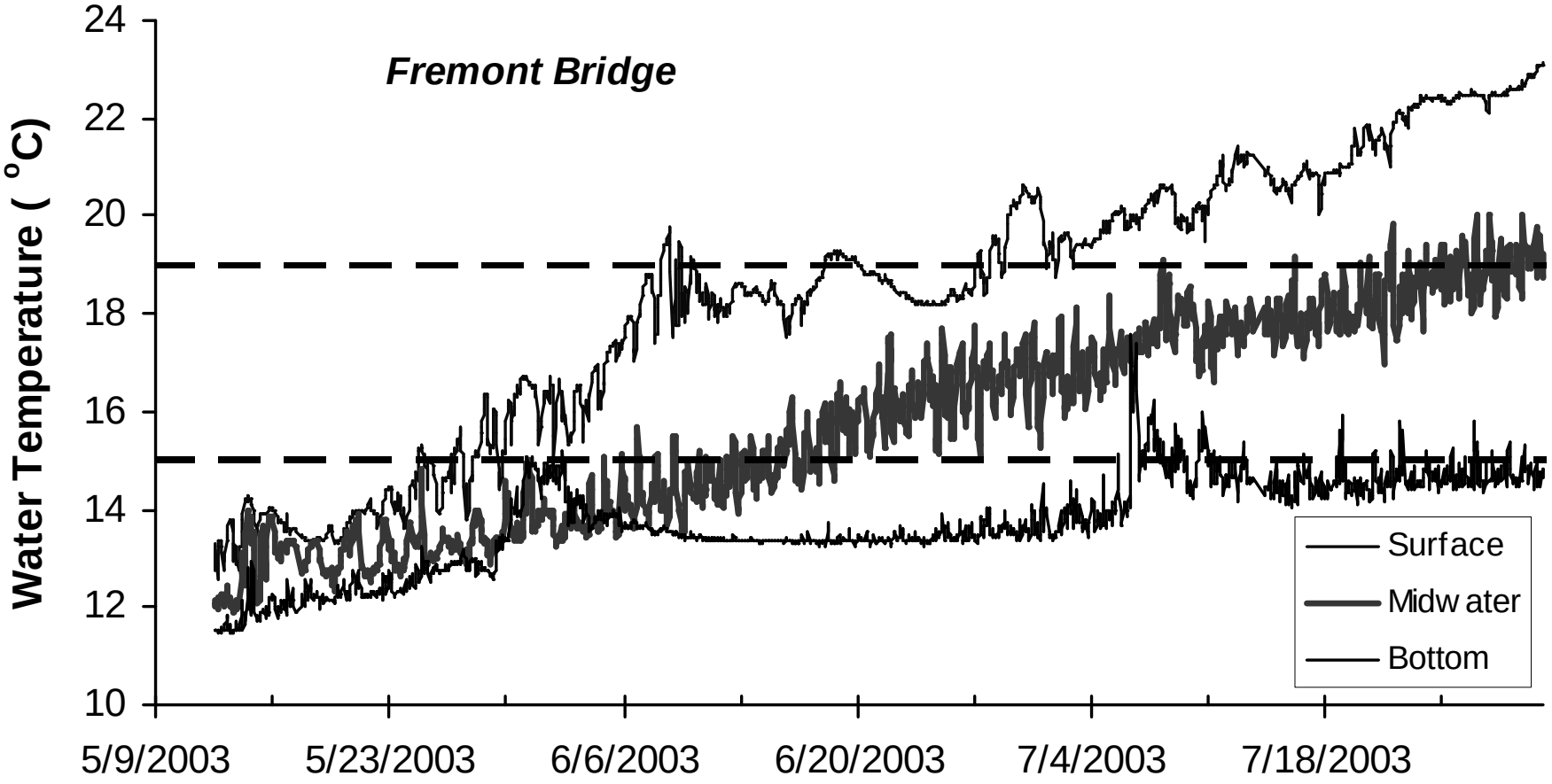


Freshwater Recapture Data – 2003

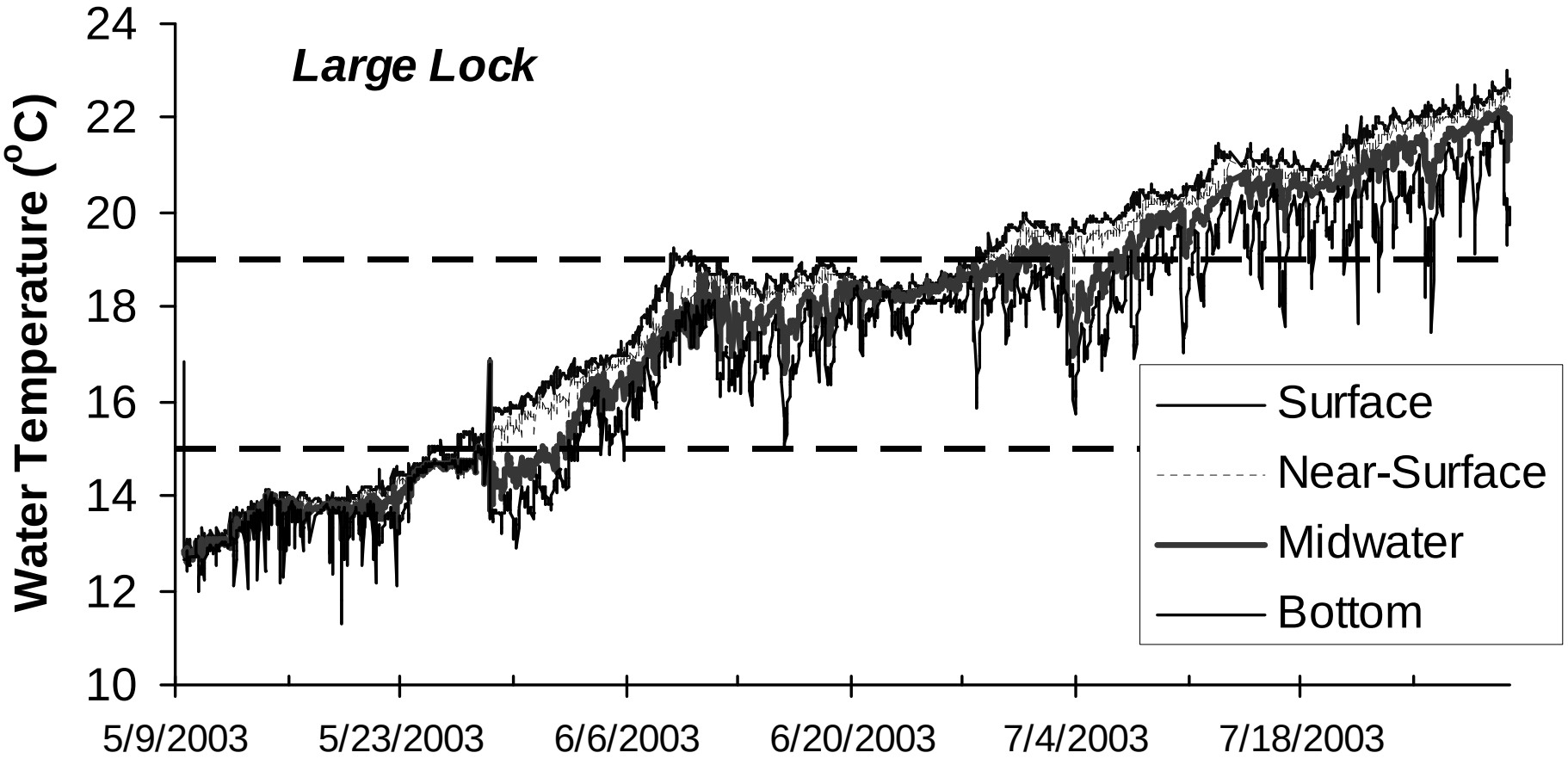
		Location of:		Migration Between Release and Recapture Locations					Subsequent Migration to Locks	
Species	**Origin**	**Tagging/Release**	**Recapture**	**Release Date**	**Days to Recapture**	**Approx. Travel Distance (km)**	**Average Migration Rate (km/d)**	**Average Growth Rate (mm/d)**	**Days**	**Average Migration Rate (km/d)**
Chinook	W	Bear Creek	Kenmore	05/29/03	1.0	29	29.6	-1.0	14	1.9
"	H	Issaquah Hatchery	Marymoor Park	05/19/03	0.9	20	22.3	20.1	*Not Detected at Locks*	
"	H	Marymoor Park	Webster Point	05/20/03	7.4	44	5.9	0.5	*Not Detected at Locks*	
"	W	Cedar River	Lake Union	05/30/03	12	33	2.7	0.4	*Not Detected at Locks*	
Coho	W	Bear Creek	Kenmore	05/05/03	7.9	29	3.7	0.6	15	1.8

Water Temperature and Detection Rates at Locks

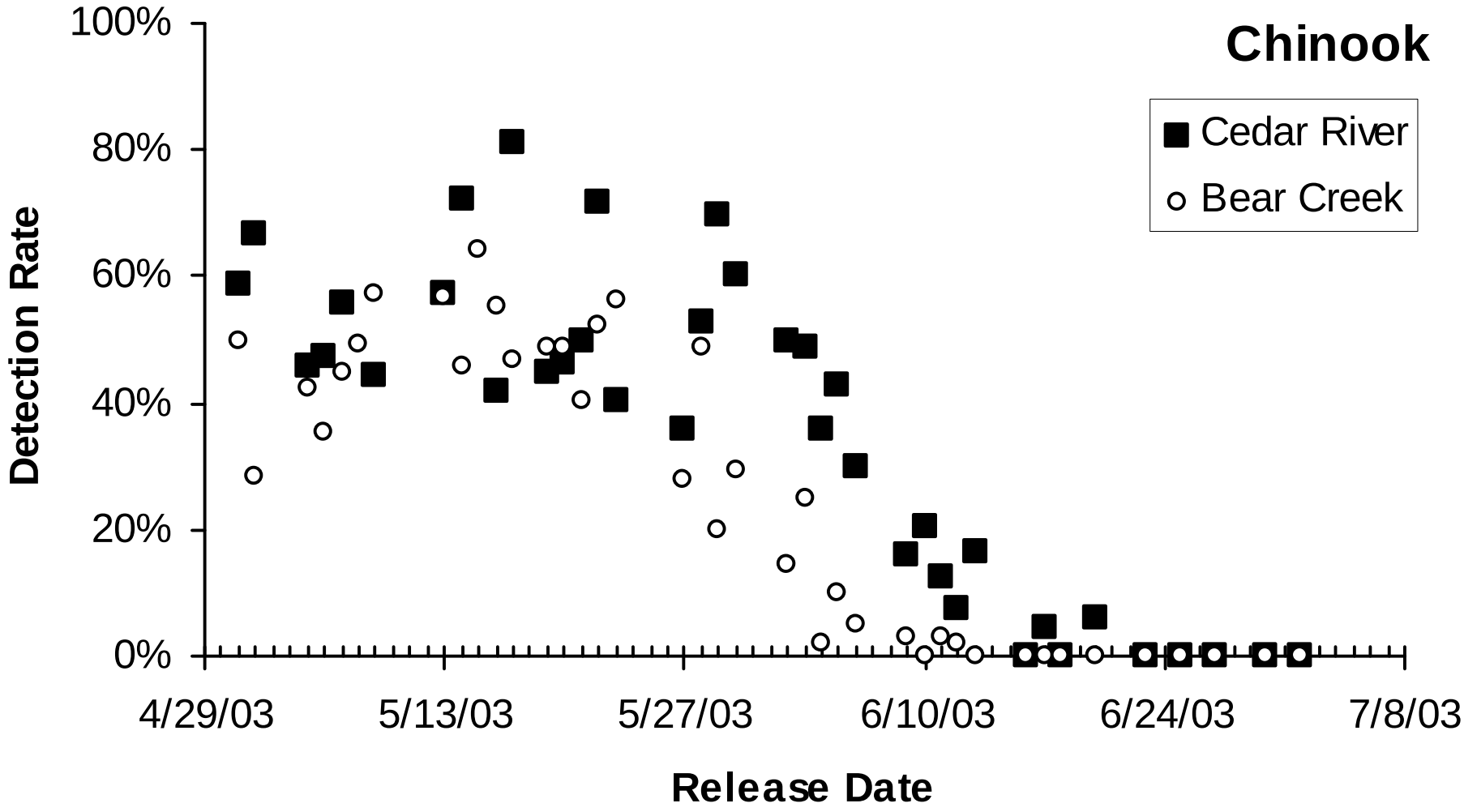
Water Temperatures



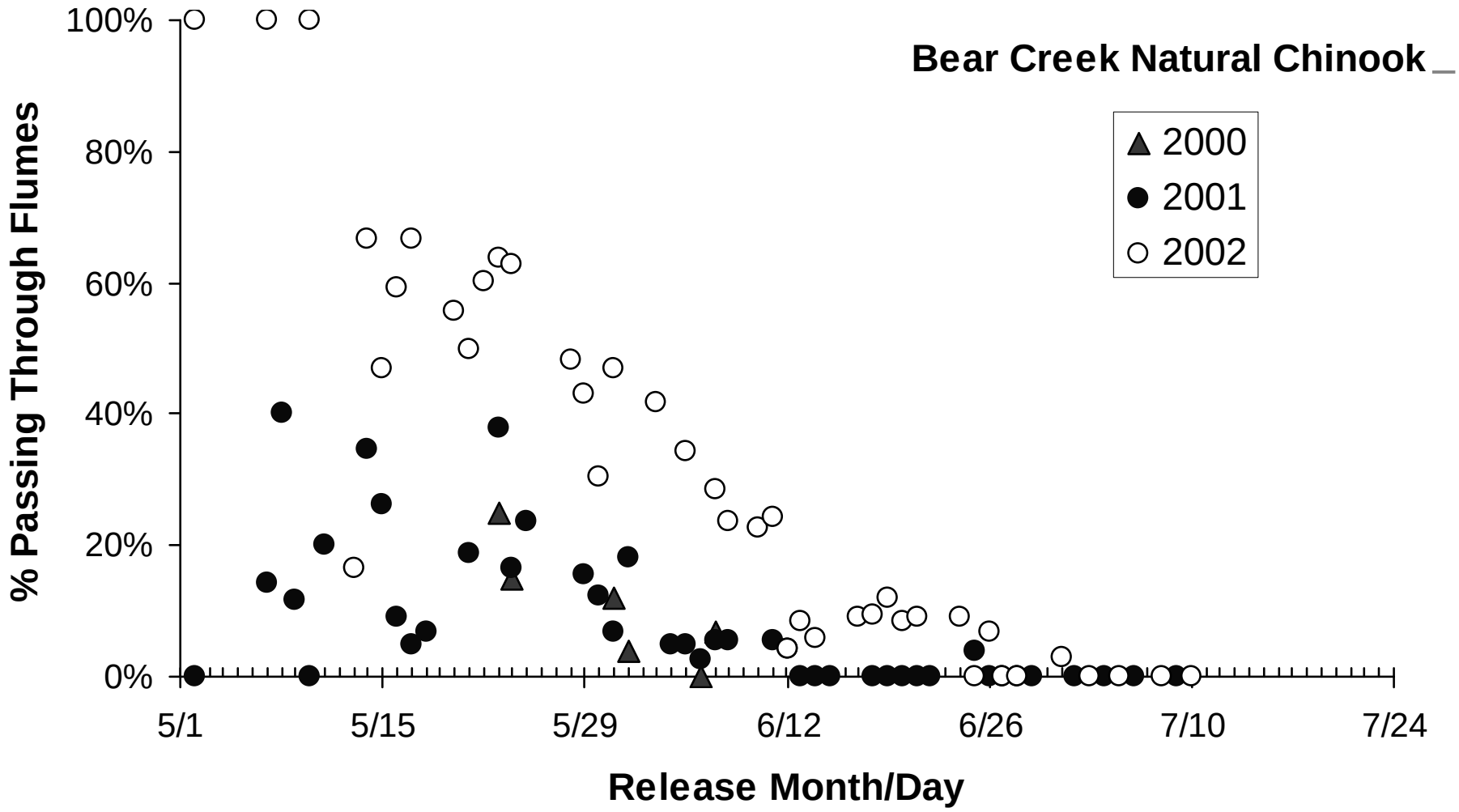
Water Temperatures



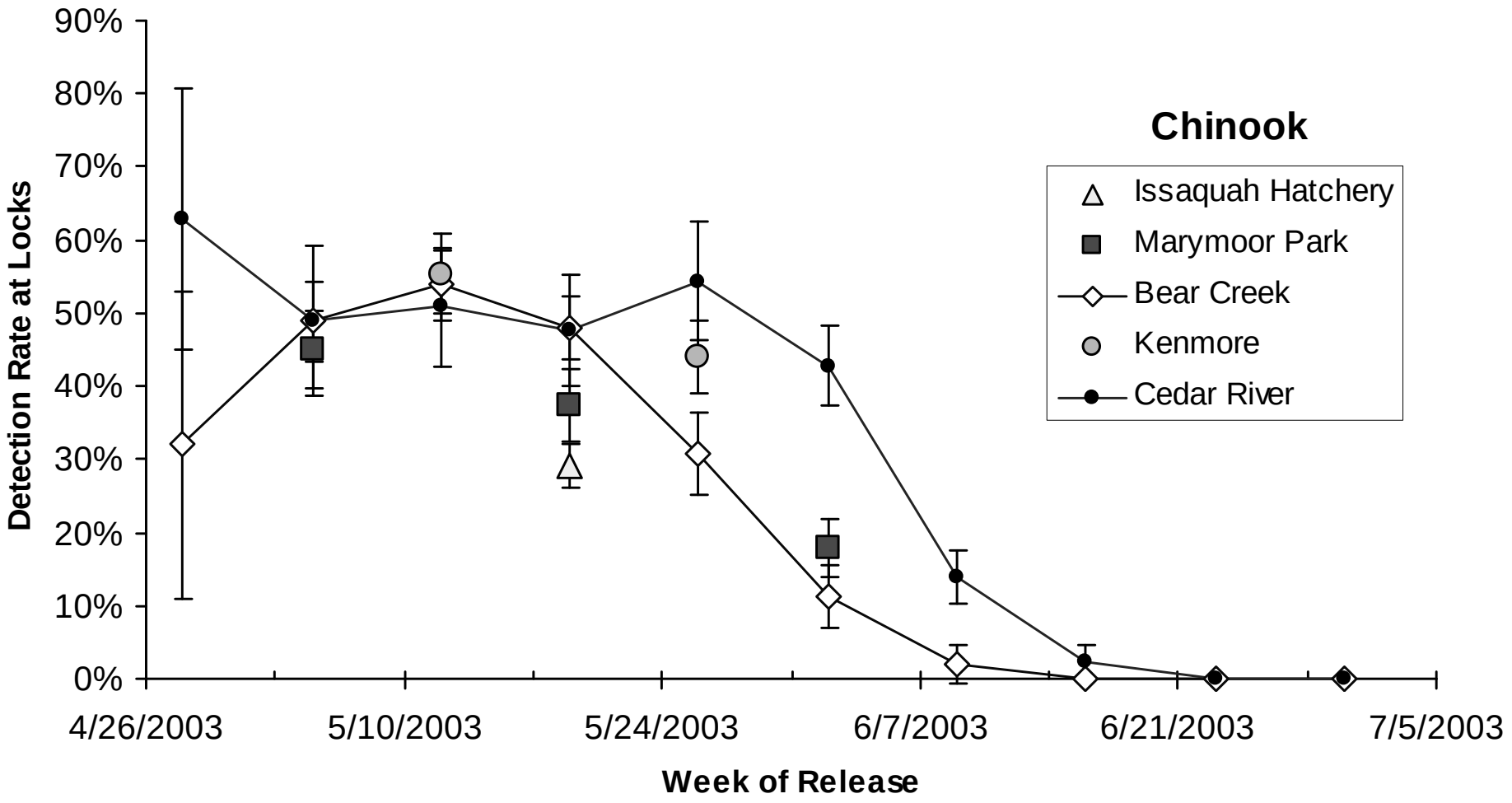
Declining Detection Rates



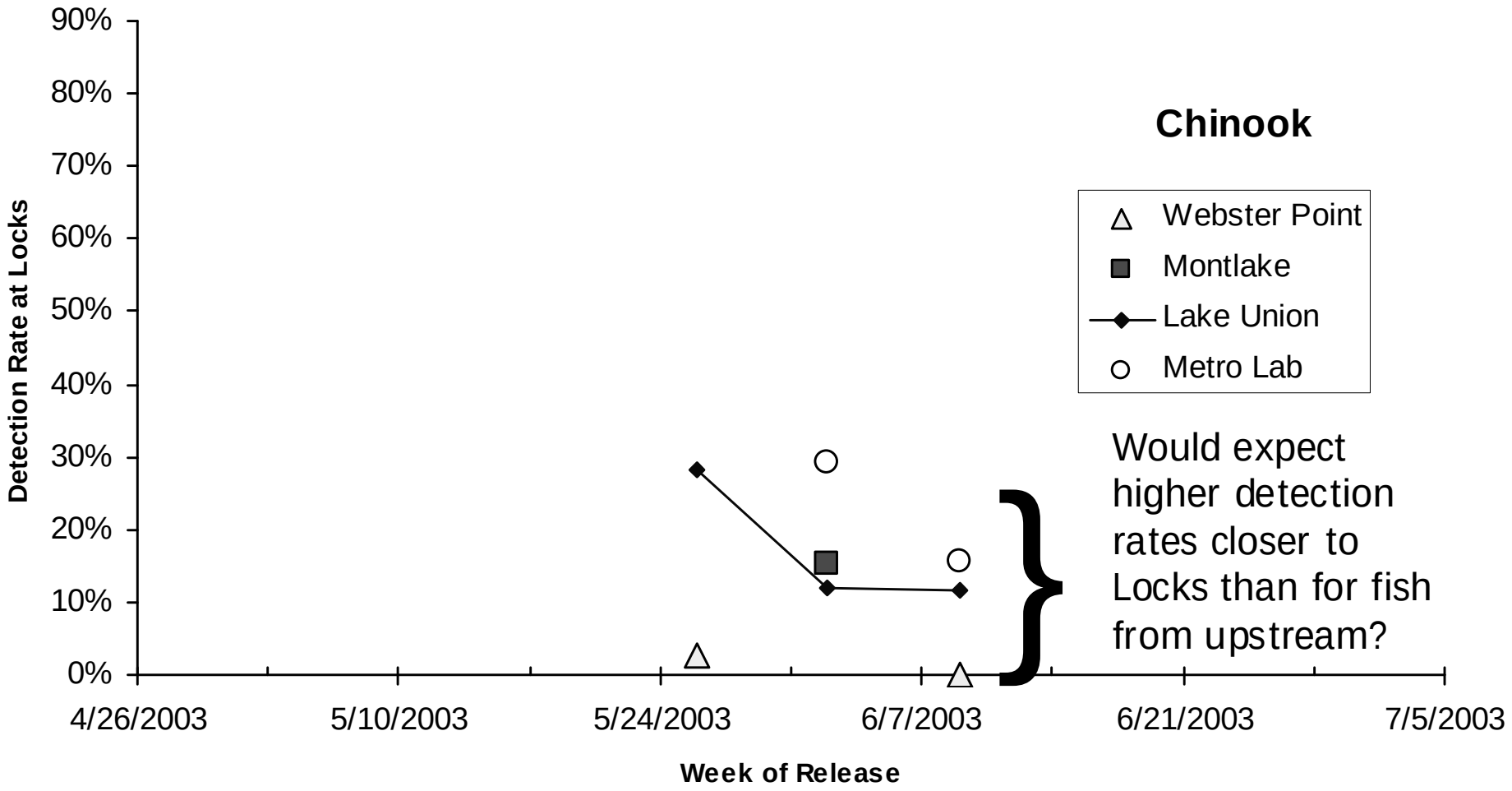
Declining Detection Rates – 2000-2002



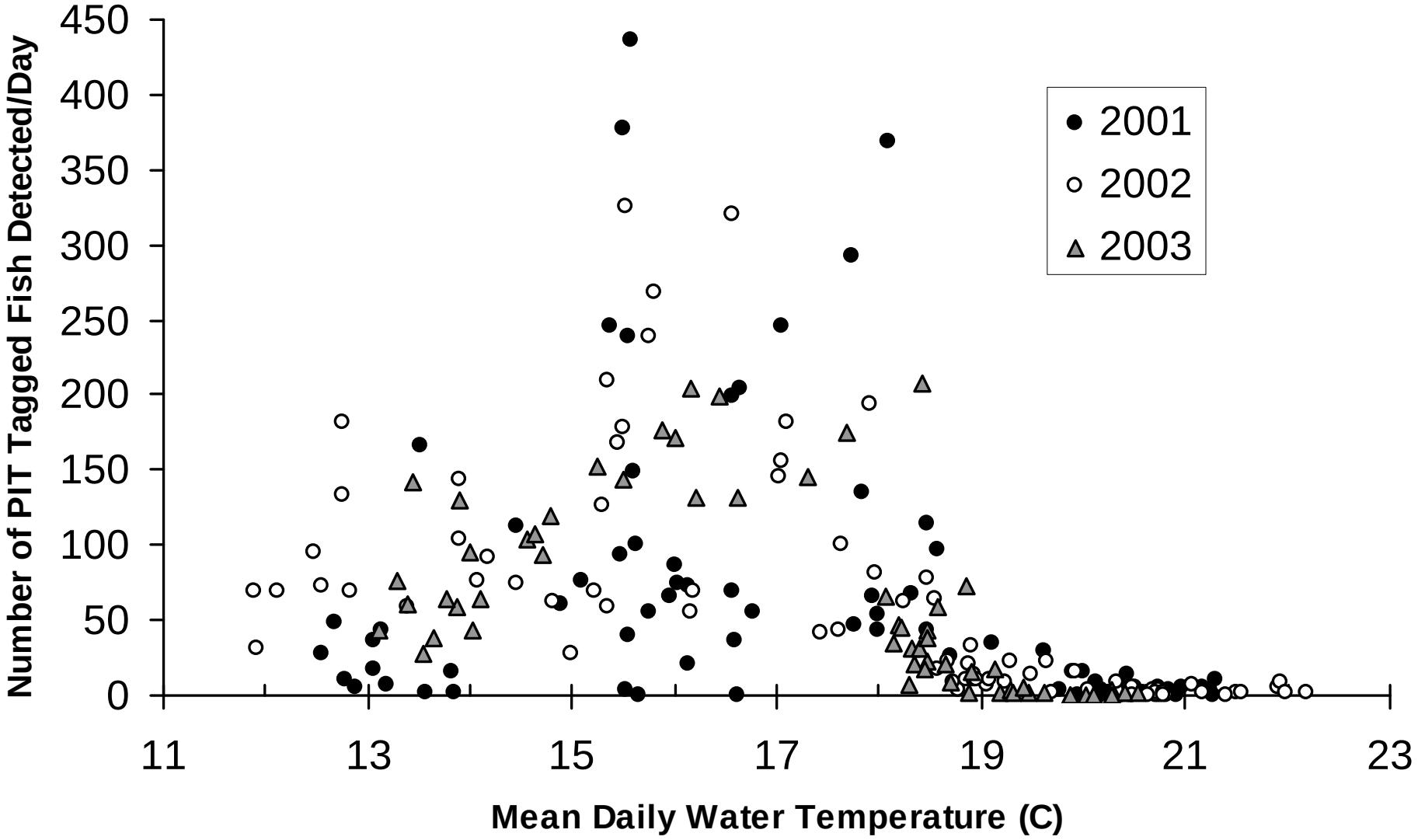
Declining Detection Rates



Declining Detection Rates?

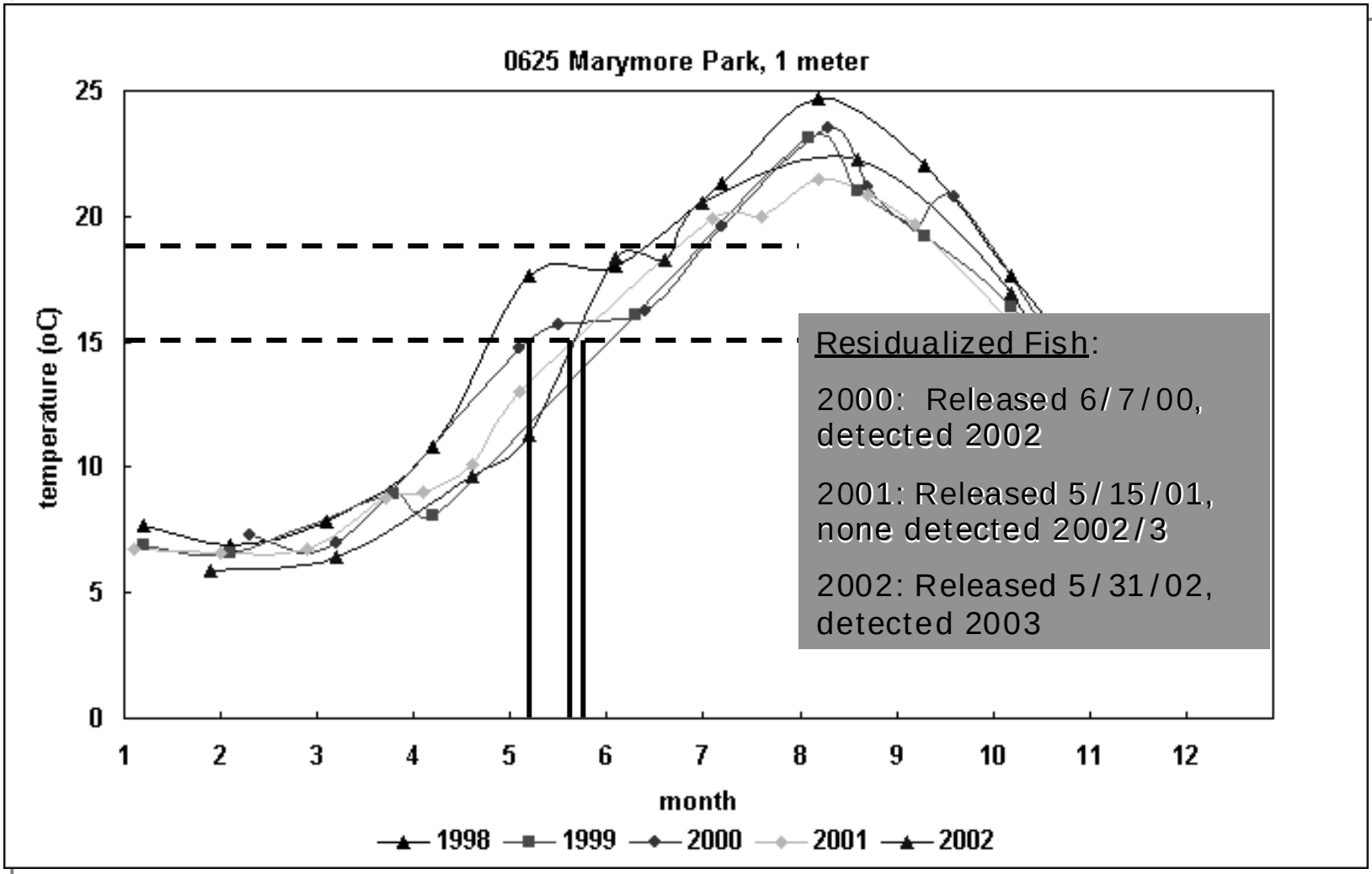


Declining Detection Rates & Surface Water Temperature at the Fremont Bridge



Surface Water Temperatures: Lake Sammamish

(Graph: King Cty Website)



Residualism, 2003 Detections

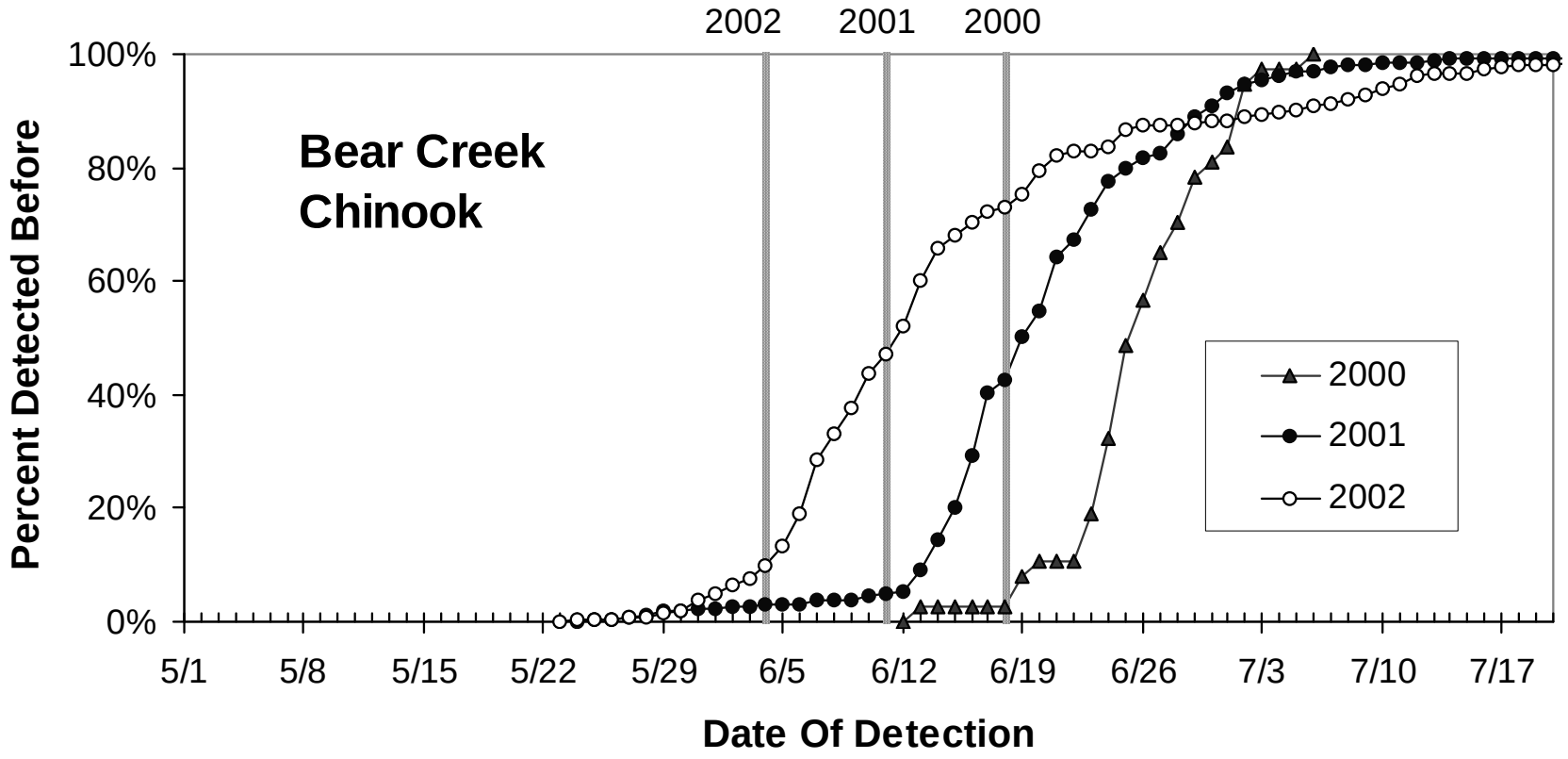
Species	Tagging Length (mm)	Release Location	Release Date	Flume Detection Date	Flume Detection Time	Interval (Days)
Chinook	131	Cedar River	7/4/2001	5/24/2003	9:10:27	689
"	76	Issaquah Hatchery	5/31/2002	6/8/2003	11:29:29	373
"	70	"	5/31/2002	6/5/2003	5:33:13	370
Coho [1]	97	Bear Creek	6/14/2002	5/9/2003	13:47:16	329
" [1]	124	"	6/21/2002	5/16/2003	7:56:57	329
Unknown	Unknown	Unknown	2001 or 2002 [2]	5/25/2003	15:45:32	na
"	"	"	2001 or 2002 [2]	6/2/2003	17:01:32	"
"	"	"	2001 or 2002 [2]	6/7/2003	6:56:48	"
"	"	"	2001 or 2002 [2]	6/26/2003	12:40:40	"

1 - Adipose fins intact.

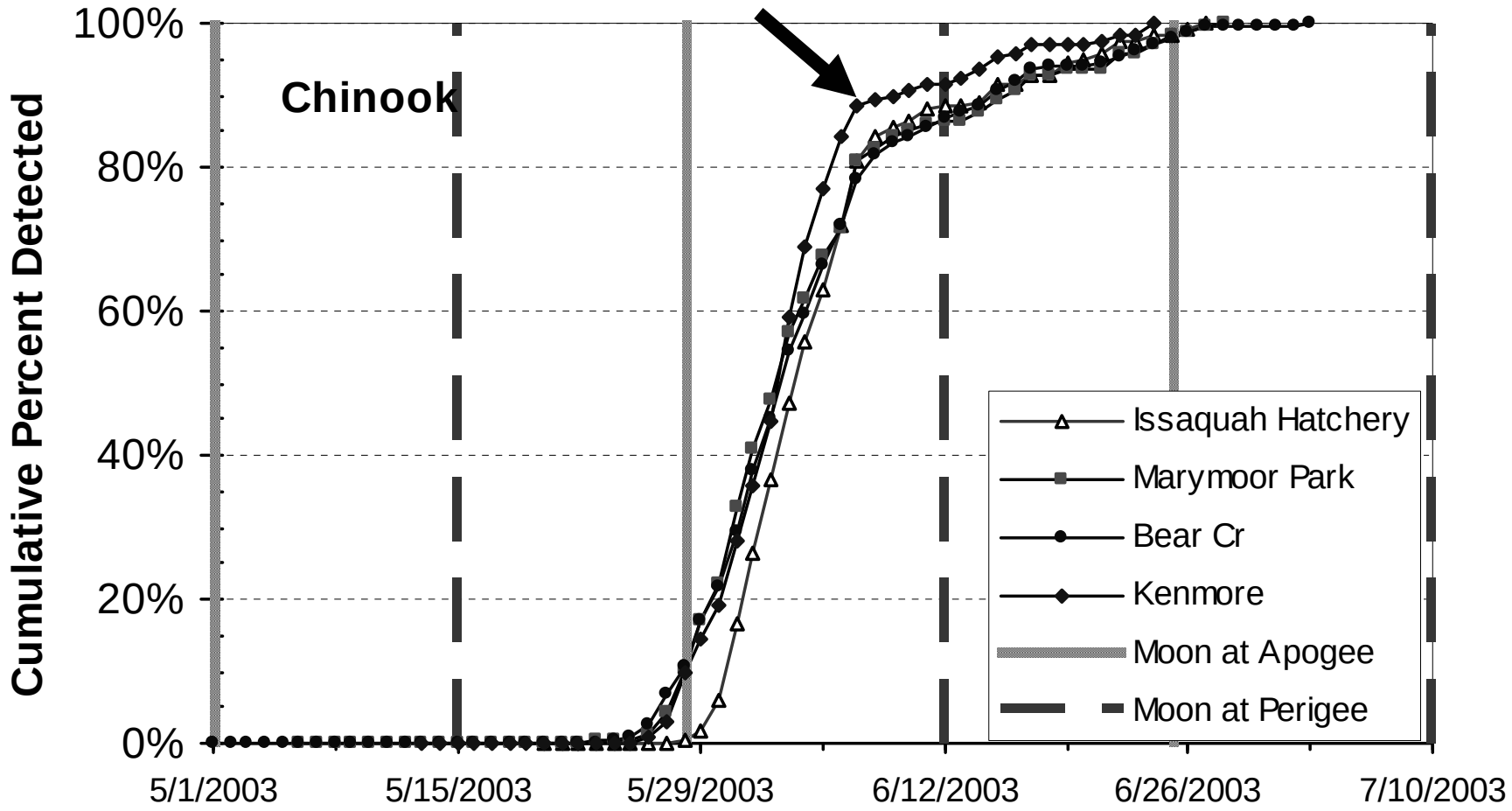
2 - Based on tag number sequencing

Lunar Influence

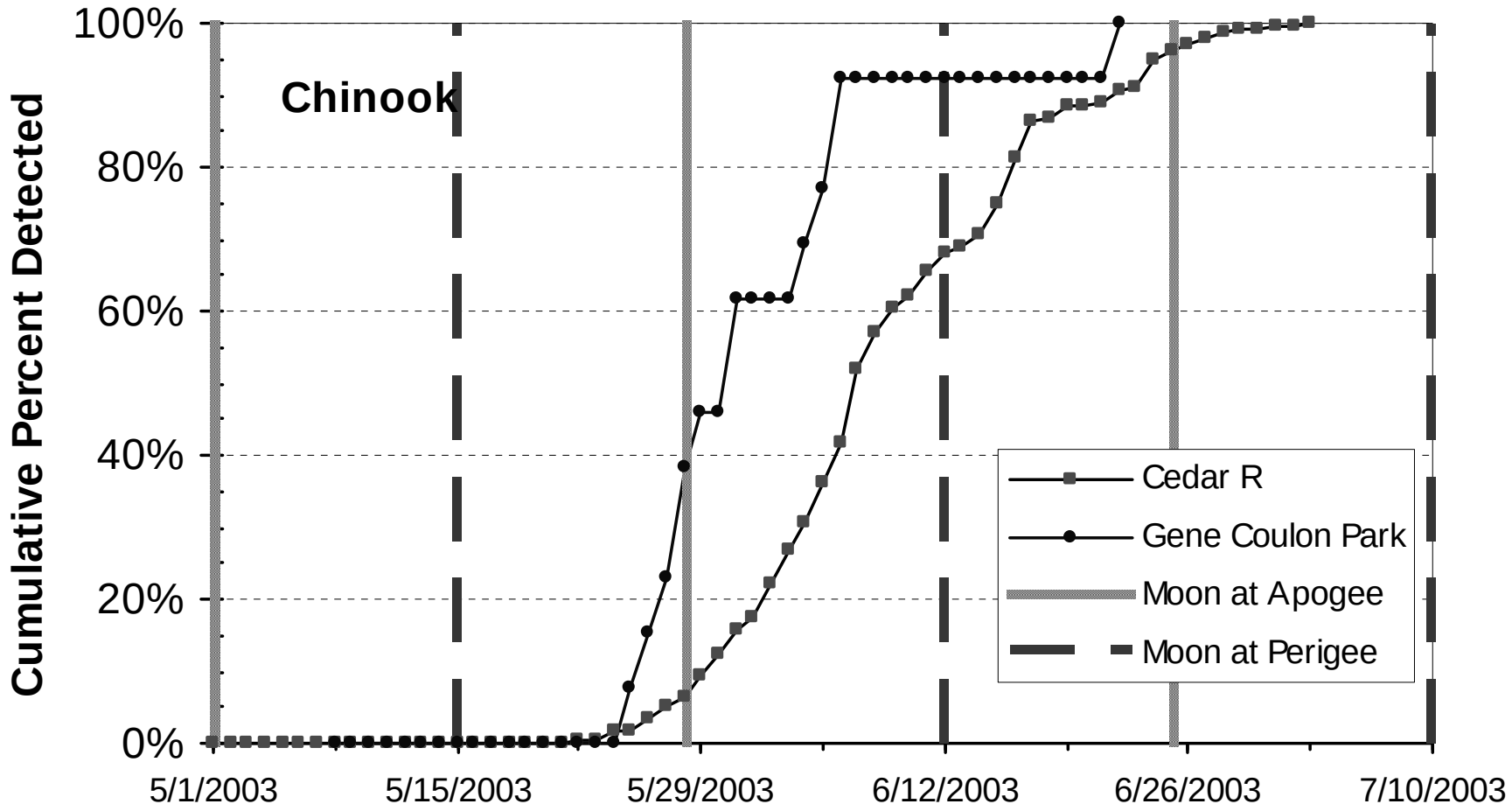
Was Apogee as important in 2003 as in 2000-2002?



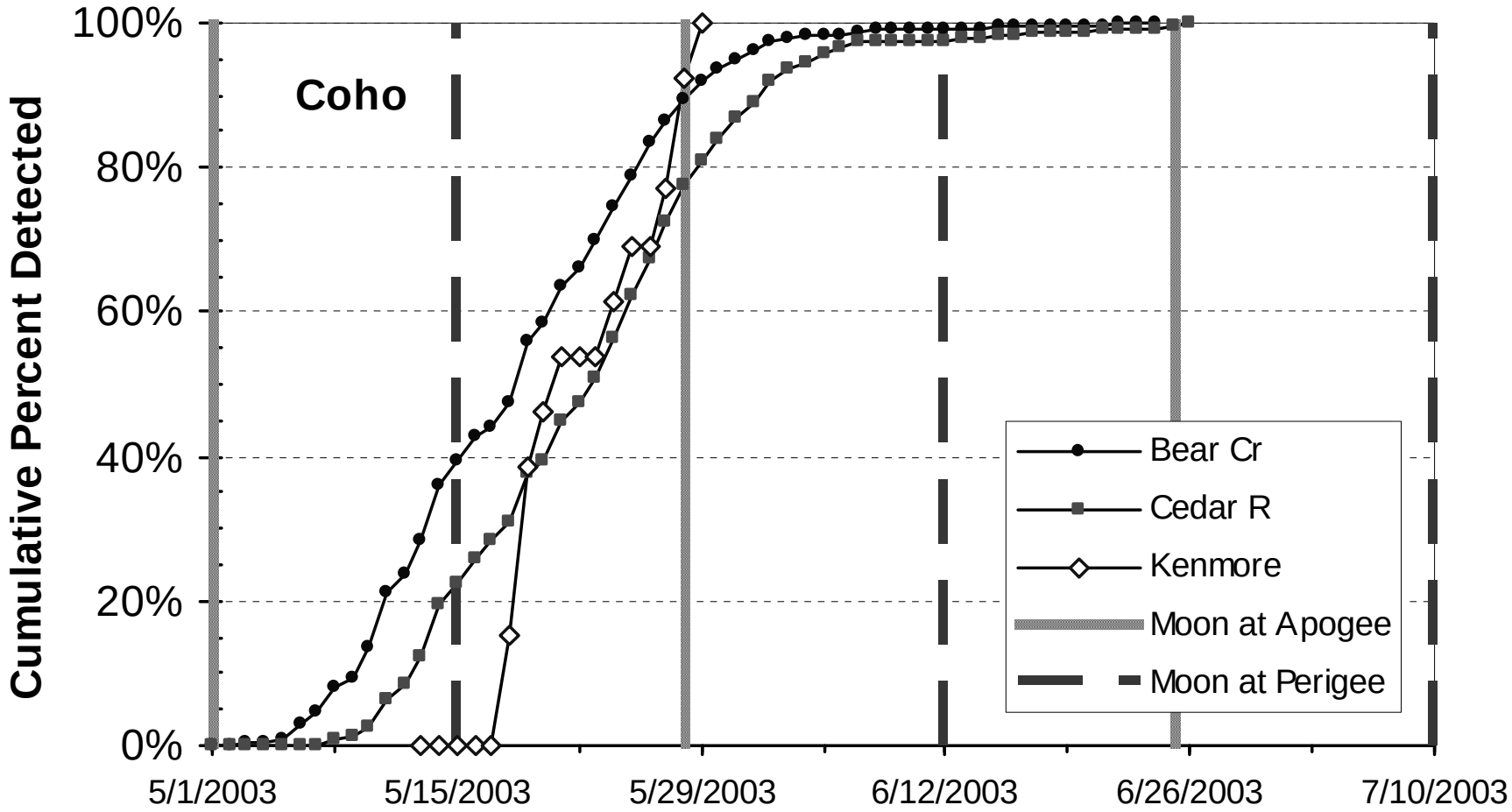
Apparently, yes...



Apogee…


Chinook
Cumulative Percent Detected
100%
80%
60%
40%
20%
0%
5/1/2003
5/15/2003
5/29/2003
6/12/2003
6/26/2003
7/10/2003
Cedar R
Gene Coulon Park
Moon at Apogee
Moon at Perigee

A-po-gee…


Coho
Cumulative Percent Detected
100%
80%
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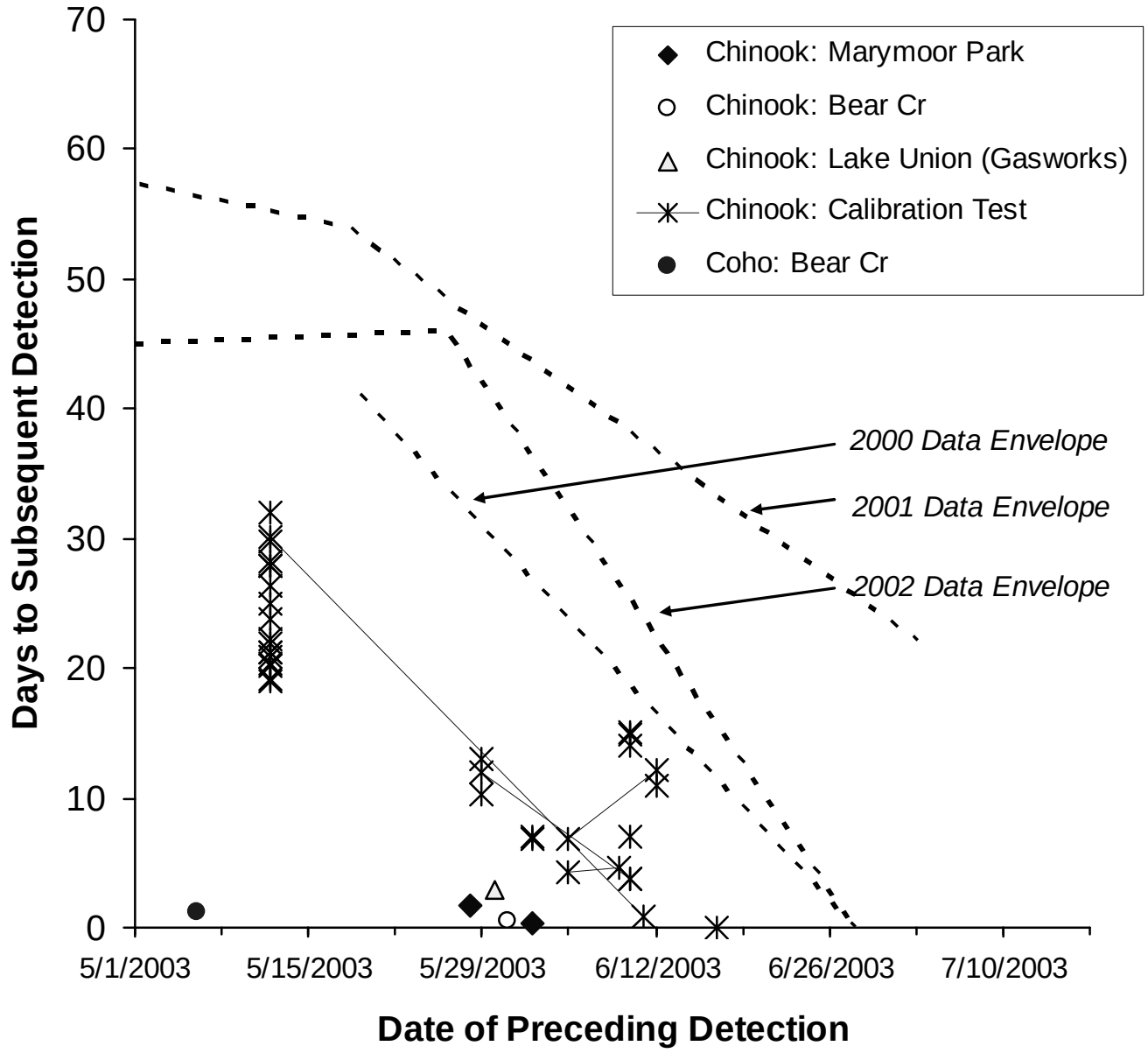
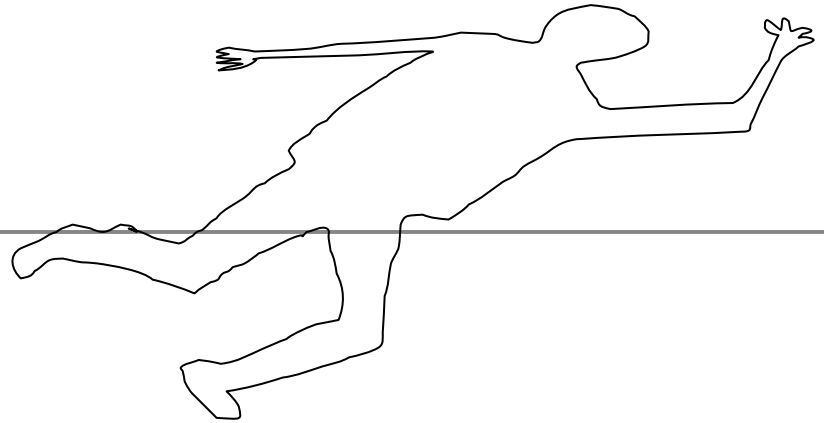
5/15/2003
5/29/2003
6/12/2003
6/26/2003
7/10/2003
Bear Cr
Cedar R
Kenmore
Moon at Apogee
Moon at Perigee

Recyclers at Locks





Survival Estimation

Estimating Survival Over Migration Route – 2003 Results

			Estimated Migration Route Segment "Survival"[4]								
Species	**Approximate Week of Detection [1]**		**Issaquah Hatchery - Marymoor**	**Issaquah Hatchery - Bear Creek**	**Issaquah Hatchery - Webster Point**	**Issaquah Hatchery - Lake Union**	**Marymoor - Kenmore**	**Marymoor - Lake Union**	**Marymoor - Metro Lab**	**Webster Point - Lake Union**	**Montlake - Lake Union**
Chinook	5/26/2003	Week of Release [2]					5/5/2003				
		U/S Detection Rate [3]					45%				
		D/S Detection Rate					55%				
		Segment Survival					**82%**				
	6/2/2003	Week of Release	5/19/2003	5/19/2003	5/19/2003	5/19/2003				5/26/03%	
		U/S Detection Rate	29%	29%	29%	29%				2.6%	
		D/S Detection Rate	37%	48%	2.6%	28%				28%	
		Segment Survival	**78%**	**61%**	***100%***	***100%***				***9.2%***	
	6/9/2003	Week of Release					5/19/2003	5/19/2003	5/19/2003		6/2/2003
		U/S Detection Rate					37%	37%	37%		15%
		D/S Detection Rate					44%	12%	12%		12%
		Segment Survival					**85%**	***100%***	***100%***		***100%***

[1] - *Based on median travel time of each release group over season (see text)*

[2] - *At upstream release point*

[3] - *Corrected for Detection Efficiency; U/S = upstream release point, D/S = downstream release point*

[4] - *Survival estimates in italics may be affected by unexplained variation*

N.B. Wide Confidence Intervals; Handling/Temperature Mortality at Lake Sites

Estimating Survival Over Migration Route – 2003 Results

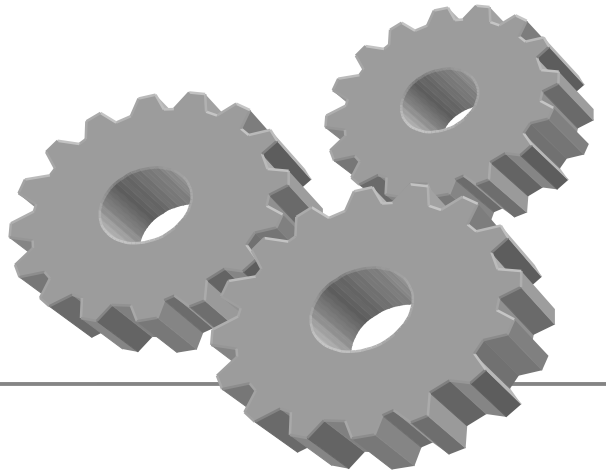
Species	Approximate Week of Detection [1]		Estimated Migration Route Segment "Survival"[4]									
			Lake Union - Metro Lab	Bear Creek - Kenmore	Bear Creek - Webster Point	Bear Creek - Montlake	Bear Creek - Lake Union	Bear Creek - Metro Lab	Kenmore - Montlake	Kenmore - Lake Union	Kenmore - Metro Lab
Chinook	5/26/2003	Week of Release [2]		5/5/2003							
		U/S Detection Rate [3]		49%							
		D/S Detection Rate		55%							
		Segment Survival		**88%**							
	6/2/2003	Week of Release			5/12/2003		5/12/2003				
		U/S Detection Rate			54%		54%				
		D/S Detection Rate			2.6%		28%				
		Segment Survival			***100%***		***100%***				
	6/9/2003	Week of Release	6/2/2003	5/19/2003		5/19/2003	5/19/2003	5/19/2003	5/26/2003	5/26/2003	5/26/2003
		U/S Detection Rate	12%	48%		48%	48%	48%	44%	44%	44%
		D/S Detection Rate	29%	44%		15%	12%	29%	15%	12%	29%
		Segment Survival	***41%***	**100%**		***100%***	***100%***	***100%***	***100%***	***100%***	***100%***
	6/16/2003	Week of Release	6/9/03%				5/26/2003	5/26/2003			
		U/S Detection Rate	11%				31%	31%			
		D/S Detection Rate	16%				11%	16%			
		Segment Survival	***74%***				***100%***	***100%***			
Coho	5/19/2003	Week of Release		5/5/2003							
		U/S Detection Rate		68%							
		D/S Detection Rate		30%							
		Segment Survival		**100%**							

Estimating Survival Over Migration Route – 2003 Results

			Estimated Migration Route Segment "Survival"[4]						
Species	**Approximate Week of Detection [1]**		**Cedar River - Gene Coulon Park**	**Gene Coulon Park - Kenmore**	**Cedar River - Madison Park**	**Cedar River - Montlake**	**Cedar River - Lake Union**	**Cedar River - Metro Lab**	**Madison Park - Montlake**
Chinook	5/26/2003	Week of Release [2]	5/5/2003	5/5/2003					
		U/S Detection Rate [3]	49%	9.1%					
		D/S Detection Rate	9.1%	55%					
		Segment Survival	***100%***	***16%***					
	6/2/2003	Week of Release							
		U/S Detection Rate							
		D/S Detection Rate							
		Segment Survival							
	6/9/2003	Week of Release			5/26/2003	5/26/2003	5/26/2003	5/26/2003	5/26/2003
		U/S Detection Rate			54%	54%	54%	54%	9.1%
		D/S Detection Rate			9.1%	15%	12%	29%	15%
		Segment Survival			***100%***	***100%***	***100%***	***100%***	***60%***
	6/16/2003	Week of Release					6/2/2003	6/2/2003	
		U/S Detection Rate					43%	43%	
		D/S Detection Rate					11%	16%	
		Segment Survival					***100%***	***100%***	

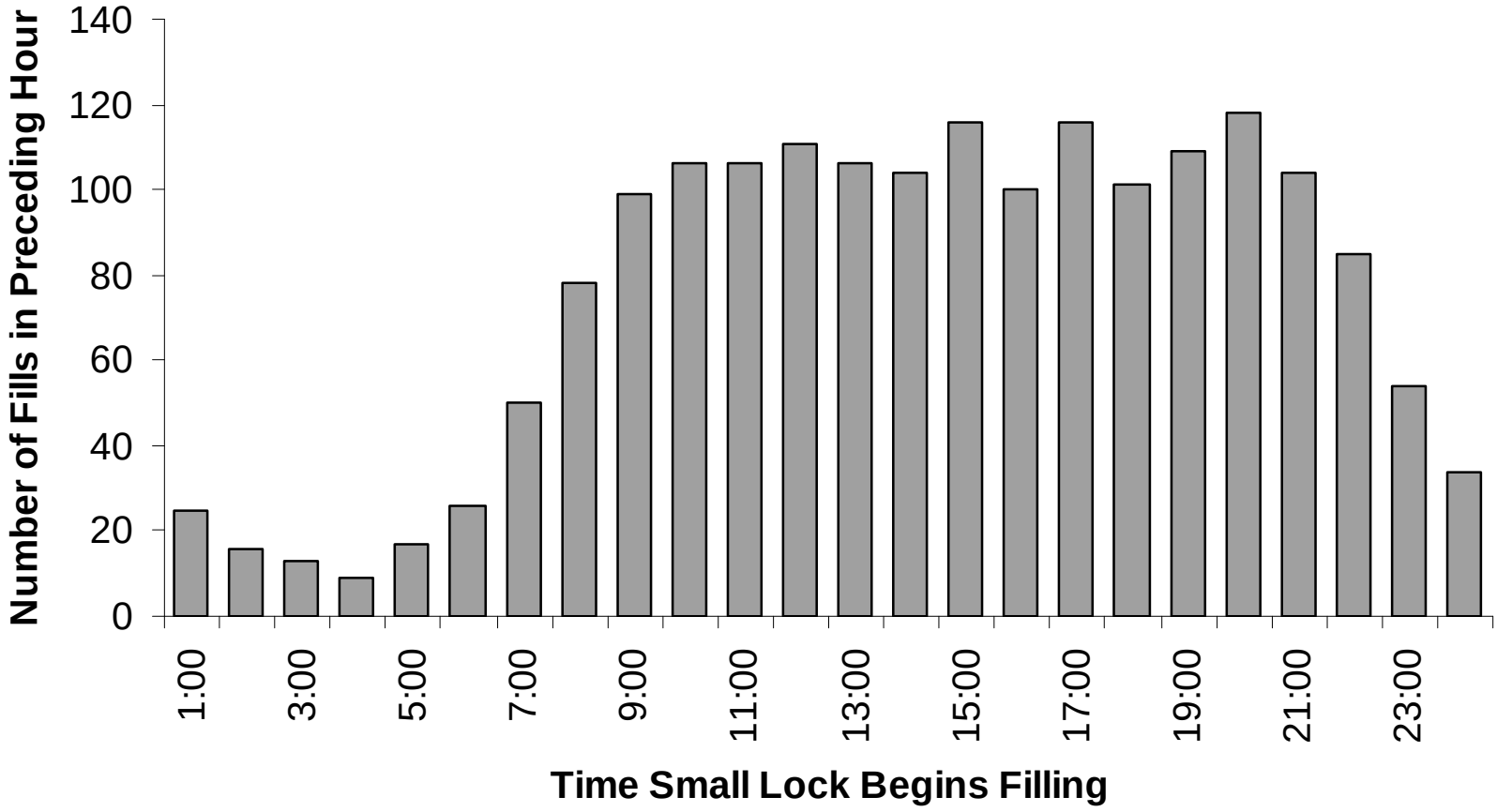
Estimating Survival Over Migration Route – Earlier Results

			Release Groups, By Week of Release					Estimated Migration Route Segment "Survival"					
Species	**Year**		**Issaquah Hatchery**	**Bear Creek**	**Cedar River**	**Montlake Cut**	**Fremont Cut**	**Issaquah Hatchery - Bear Creek**	**Bear Creek - Montlake Cut**	**Bear Creek - Fremont Cut**	**Cedar River - Montlake Cut**	**Cedar River - Fremont Cut**	**Montlake - Fremont Cut**
Chinook	2001	Week of Release	--	5/14/2001	5/21/2001	5/28/2001	6/4/2001	--	53%	57%	100%	100%	100%
		No. Released	--	357	142	110	33						
		No. in Flumes [1]	--	71	63	41	8						
		Week of Release	5/14/2001	5/21/2001	5/28/2001	6/4/2001	6/11/2001	100%	54%	60%	81%	90%	100%
		No. Released	4676	320	374	236	160						
		No. in Flumes	1762	74	131	102	62						
		Week of Release	--	5/28/2001	6/4/2001	6/11/2001	6/18/2001	--	34%	44%	67%	87%	100%
		No. Released	--	685	320	255	551						
		No. in Flumes	--	89	82	98	162						
		Week of Release	--	6/4/2001	6/11/2001	6/18/2001	6/25/2001	--	27%	14%	94%	50%	58%
		No. Released	--	277	360	23	516						
		No. in Flumes	--	13	59	4	170						
	2002	Week of Release	5/28/2002	5/28/2002	5/28/2002	5/28/2002	6/4/2002	100%	84%	100%	87%	100%	100%
		No. Released	4024	463	84	300	370						
		No. in Flumes	1570	191	36	147	153						



Locks Operations and Passage

Small Lock Operations May Influence Passage Rates



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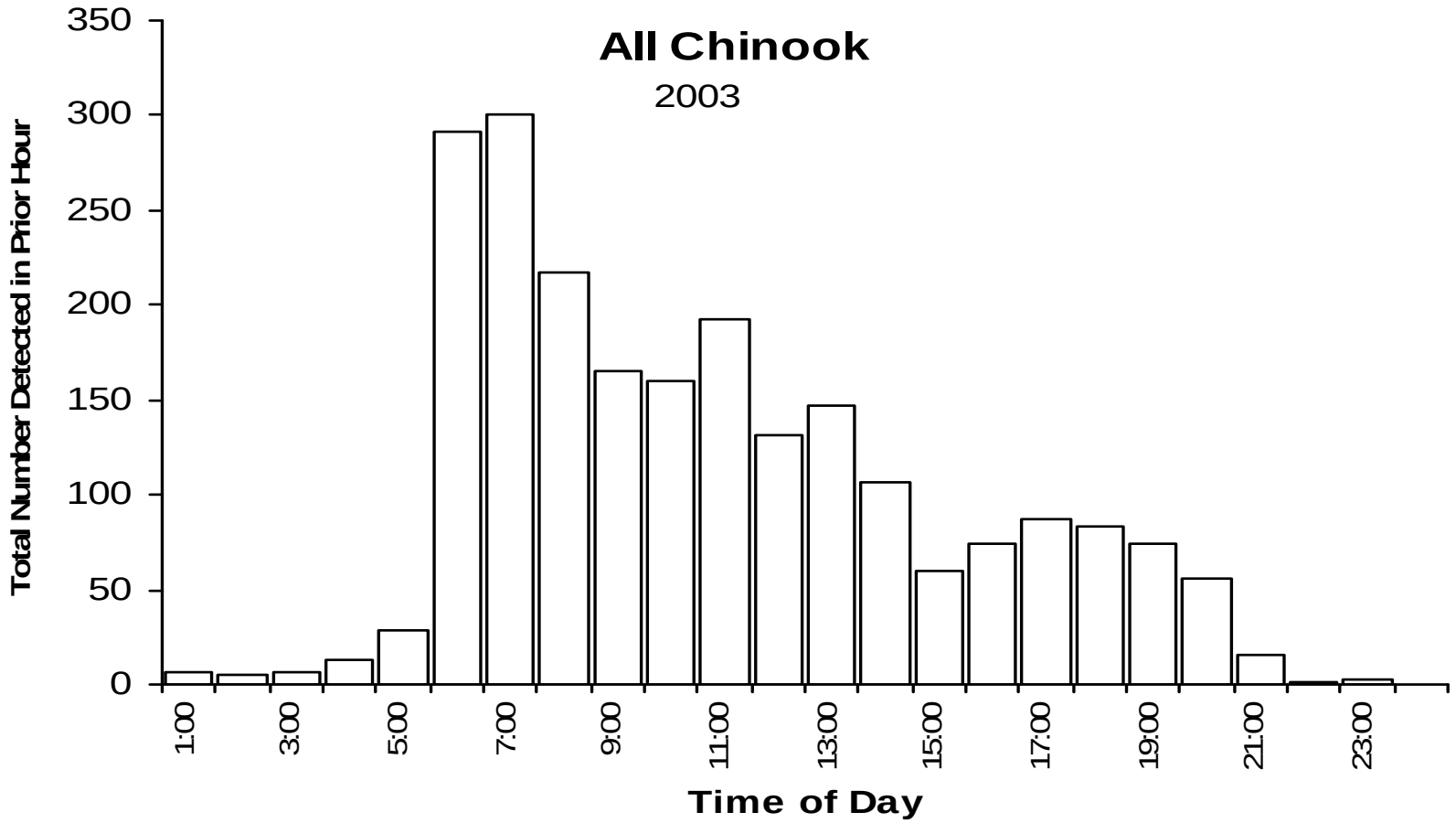
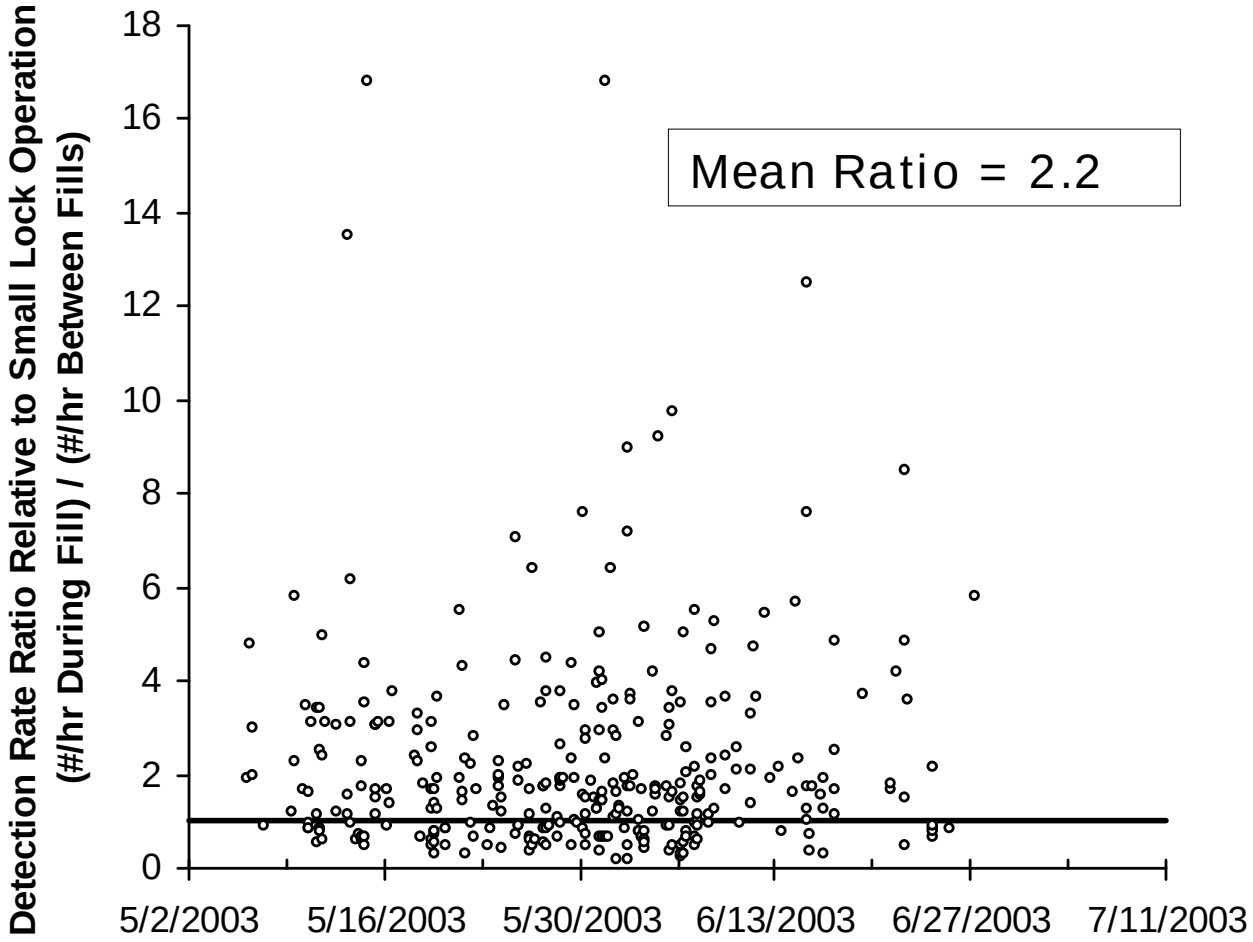
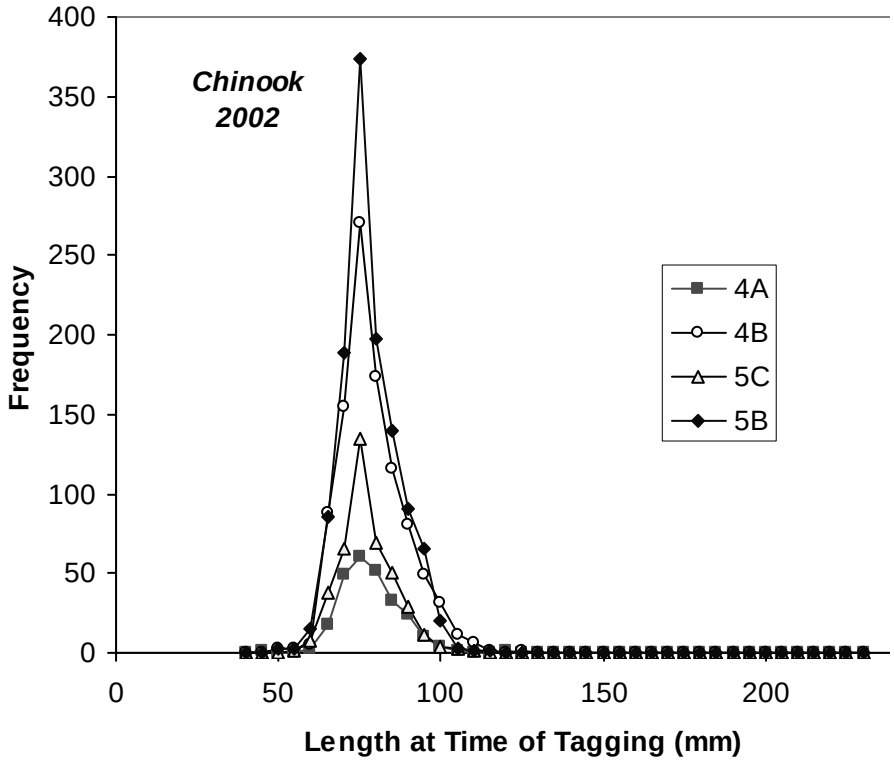
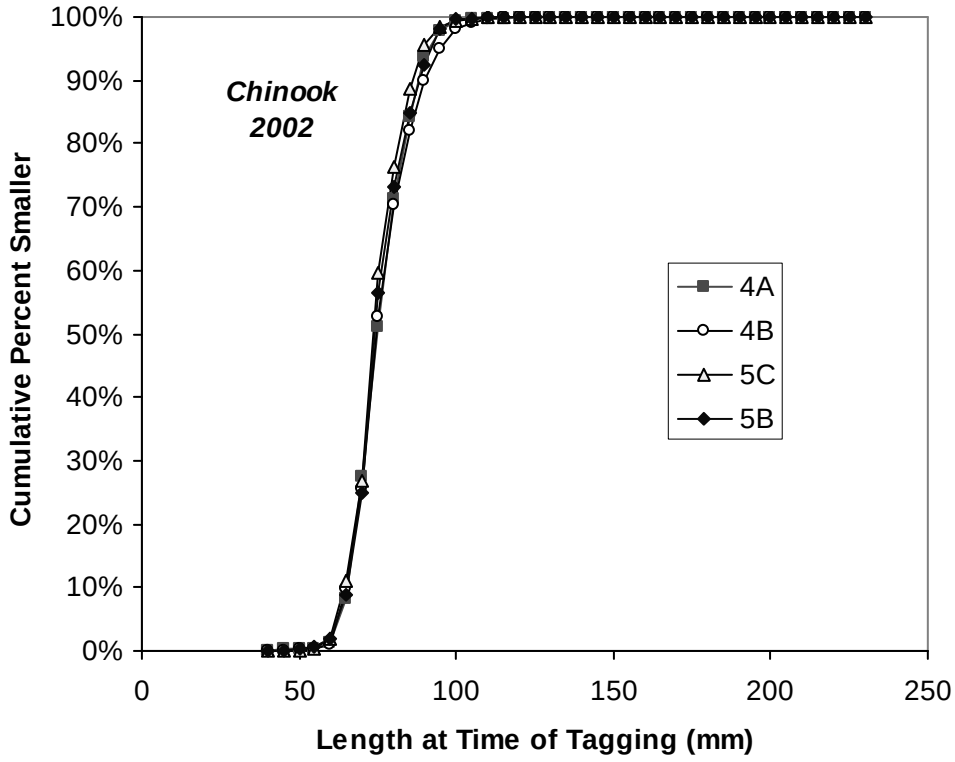


Passage Rates are ~Twice During Than Between Small Lock Fills:

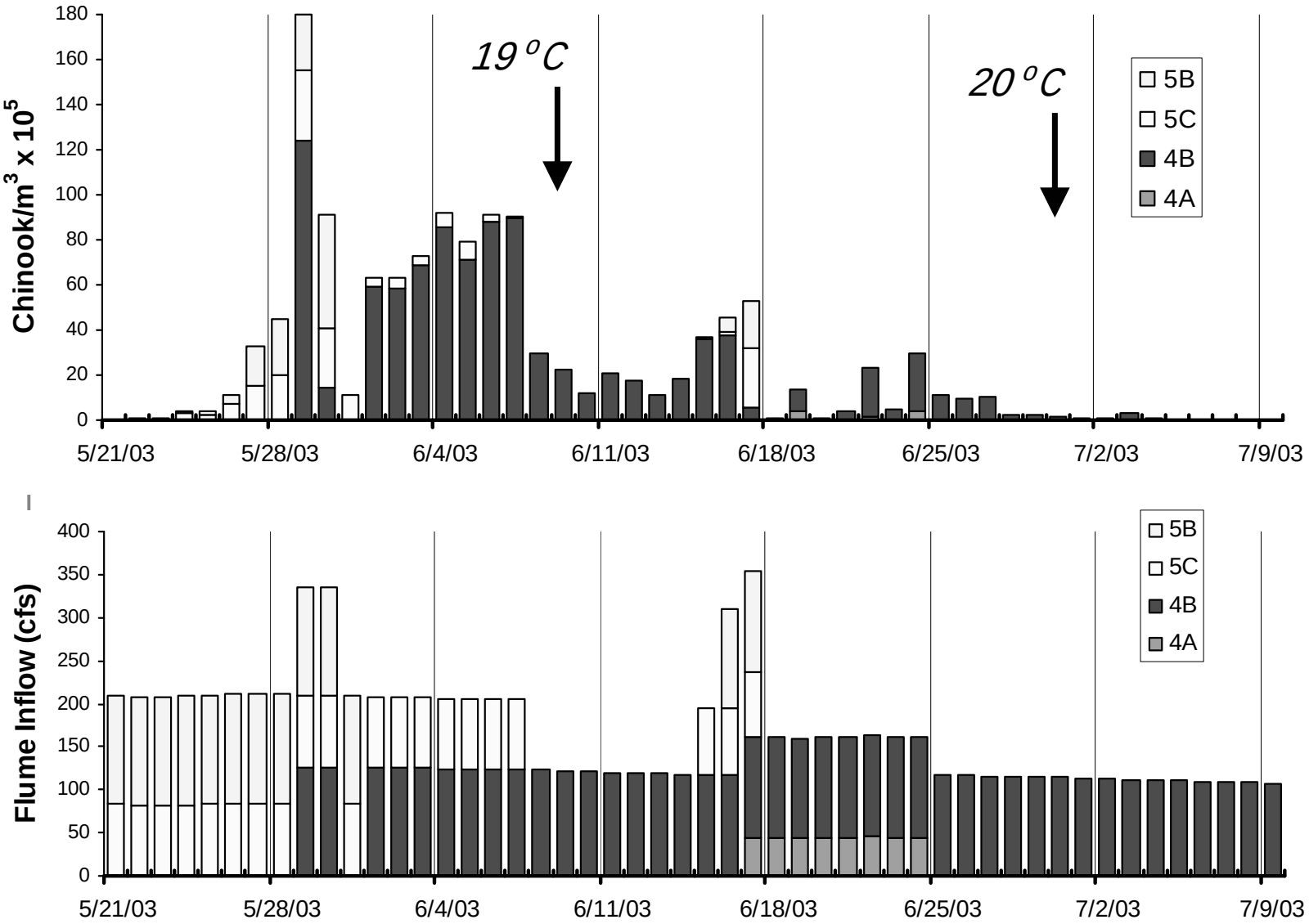


Flume Size May Influence Number of Fish, But Not Size of Fish Passed:





Water Efficiency



Future Directions

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- Shoreline habitat in lakes important until when?
- How to determine when and how much smolts use other routes through Locks than smolt flume, and operate flumes/Locks accordingly?

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- How can smolt flumes/locks be operated optimally for fish and water?